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Similar studies have been made also in conjunction with the exceedingly important investigations of underground water resources of several important drainage basins, upon which a number of hydrologists have been employed in the West. Plans have been formulated for developing and utilizing power in construction work, thereby effecting a considerable saving in labour and time and in the first cost of permanent structures.

VAN DER GRINTEN'S CIRCULAR PROJECTION.

BY

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Owing to the geometrical impossibility of developing a spherical or spheroidal surface in a plane, geographers have adopted various artifices, called projections, for representing, on a reduced scale and on a plane surface, the relative positions of points, lines, or objects on the earth's surface; and, since such positions are usually defined by spherical co-ordinates, the primary object of these artifices is the delineation of these circles of reference so that any point, line, or object intended for representation may be laid down according to its known co-ordinates. These so-called projections fall in three classes or subdivisions. The first comprises the true or perspective projections, like the orthographic and stereographic, in which the framework of parallels of latitude and meridians of longitude is represented as a spectator would see them on a plane surface placed in a definite relative position back of the globe upon and through which he is looking.

The second class is made up of those projections like the Mercator and the conic, in which the lines of spherical co-ordinates are first projected upon a circumscribing cylindrical or conical surface, which is afterwards conceived to be developed upon a plane surface by being cut open along an element of the cylinder or cone and then spread out flat.

The third class includes those projections which are neither formed by projection nor by development, but which are conventional constructions based upon geometrical laws, either assumed or fixed, and not representing the earth in such a way that it could be seen in that form by a spectator in any position whatsoever. Lambert's projection and Mollweide's or Babinet's homolographic

projection belong to this class, which has lately been extended by Mr. Alphons van der Grinten in a purely geometrical construction for the representation of the whole world within a circular bounding meridian by means of a network of parallels of latitude extending from pole to pole and of meridians of longitude extending throughout the circuit of the globe. The accompanying figure 1 will serve to indicate the method of construction. First describe a circle representing the marginal meridian inclosing an area equal to the surface of a sphere or globe of half the diameter of the circle, or, in other words, of twice the diameter of the given globe. Then draw the horizontal and vertical diameters of this circle to represent the equator and the middle meridian respectively. In the figure the equator is represented by the line AOA', and the middle meridian by the line NOS. As the construction is identical in each of the four quadrants of the circle thus formed, it will be sufficient for the purpose of explanation if the construction is confined to two of the quadrants. Let the line OA' be divided into a number of parts of the same length equal to half the total number of meridians to be shown on the globe, and the line ON into one-half as many equal parts as are shown along OA'; and let these points of subdivision be numbered as indicated in the figure. To draw a parallel of latitude representing, for example, the sixtieth-degree parallel of north latitude, from the point numbered 6 on the middle meridian ON draw the chord BC perpendicular to ON; and then draw the chord CA', intersecting the line ON in the point D. The arc of the sixtieth-degree parallel will cross the central meridian ON at the point D. The chord AN is next drawn intersecting the chord BC in the point E, which is to be connected by a straight line with the point A' for the purpose of locating the point F in which the line EA' intersects the middle meridian. The chord which subtends the required parallel of sixty degrees of latitude crosses the middle meridian ON at the point F, so that FG drawn perpendicular to ON will represent half of that chord and a circular arc described from a centre J on the prolongation of the line ON and passing through the points G and D will be the required sixtieth-degree parallel of latitude. In a similar manner the remaining required parallels may be drawn.

The meridian lines are constructed by describing from centres, as M, on the line AA' produced, a succession of arcs passing through the successive points of subdivision of the equator and the points N and S. One-half of one of such arcs is shown in the figure by the heavy line SR.

By this method of construction the number of meridians shown is double the number of parallels, so that if the parallels represent ninety degrees on each side of the equator, or a total of one hundred and eighty degrees, the meridian lines will indicate three hundred and sixty degrees; and a map drawn with reference to this network of parallels and meridians is capable of representing the entire surface of the earth.

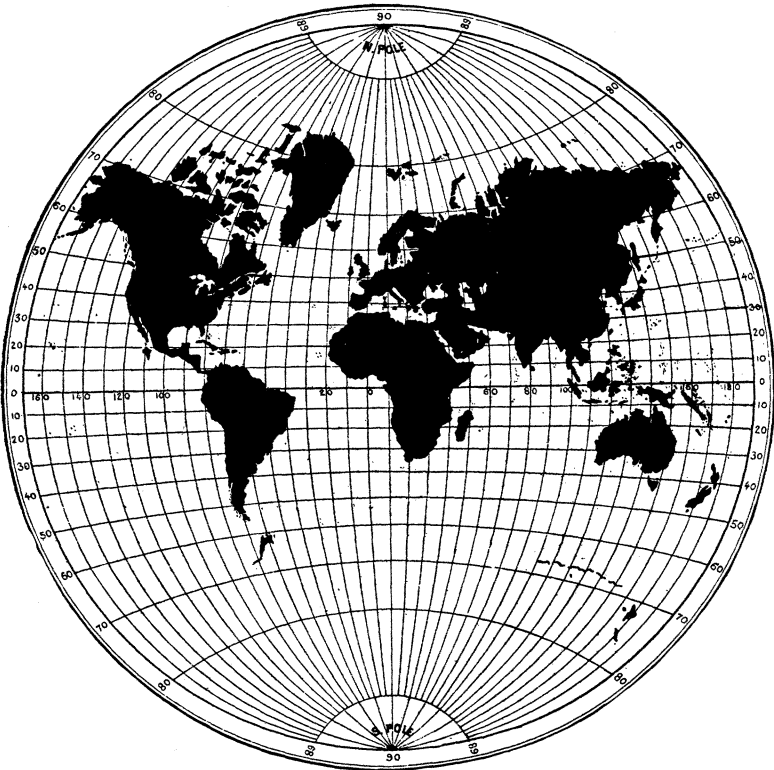
**CONTINENTAL VIEW**

FIGURE 2.

The new projection appears to occupy a middle ground between Mercator's nautical chart of the world and Mollweide's homolographic map of the world, avoiding the enormous distortion of the former, by which it becomes impossible to represent the poles at all, and greatly lessening the rapid departure from the true angles of intersection between the parallels and meridians which takes place in the latter. There is no distortion along the equator, and therefore the longitude on the map corresponds with the actual differ-

ence of time between places situated on the surface of the earth; but the distortion grows with increase of latitude, and becomes a maximum in the polar regions, where, however, the departure from the true size and shape of the earth's features is of the least importance for all the usual geographical and physical uses of maps.

In the development upon a plane of any non-developable surface, like a sphere, certain errors are, of course, unavoidable; but any of these errors may be diminished, or even made to disappear altogether, at the cost of increasing some other. Thus in Mollweide's projection much has been sacrificed to secure the characteristic condition of strict proportionality between areas on the sphere and the corresponding areas of the projection; and likewise, in Mercator's, other useful attributes have been given up to attain the characteristic condition of the projection, that the track of a ship pursuing the same true course throughout a voyage will be represented by a straight line drawn between the ports of departure and destination.

Van der Grinten's projection appears to be without special characteristics of the kind just referred to, but to have been designed rather with a view of securing a natural and suggestive method of showing the whole world upon a single projection, in such a manner as to convey the idea of its globular form and to represent its main features without violent departures from their true shapes and areas.

THE FLOOR OF THE NORTH ATLANTIC OCEAN.

Sir John Murray has prepared a long paper and a map in which he deals with the "Recent Contributions to our Knowledge of the Floor of the North Atlantic Ocean." The paper is printed as an *Extra Publication* by the Royal Geographical Society.

The author says that the latest additions to our knowledge of the depths of the North Atlantic come from the expeditions of the Prince of Monaco and from several cable ships. The investigations which he takes into consideration are limited to the North Atlantic Basin between Lat. 20° and 60° N., excluding the tributary seas along the margins. The total area dealt with is about 6,875,000 square geographical miles. Between the limits indicated over 70 per cent. of the area of the sea-floor is covered by water